

THE STATE OF THE ART MONTHLY NEWS AND INFORMATION SERVICE

THE PROMISED PRODUCTIVITY

How long before these obstacles are overcome? Our guess: About two to three years. In that time, people costs will so far outstrip automation costs as to make retooling a requirement for survival. The pressures of competing in the international marketplace will also contribute to manufacturers' awareness of the need to automate.

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SEE PAGE:

This image shows a single sheet of cream-colored paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

More and more, vendors will recognize their need for intimate knowledge of their prospects' businesses.

Complete "automated factory" turnkey systems will develop, facilitated by the emergence of a new service vendor: The factory automater. The factory automater will act on the client's behalf to select, design and adapt technology to automate the entire manufacturing process.

The future looks bright - for those who are prepared. *Joel N. Orr, Editor*

PERSONNEL PRODUCTIVITY POINTS

OPERATOR TRAINING TIPS / EDUCATION PREPARES FOR TRAINING

When considering the training of operators for computer-aided design and drafting systems, as well as for systems that are going to involve computer-assisted manufacturing, it's important to recognize the difference between training and education. The purpose of education is to dispel ignorance and fear, while the purpose of training is to impart specific skills. Usually education is dealt with rather haphazardly, while training receives all of the attention in the introduction of a new technology. That is, management's concern is with the imparting of the specific skills required to make the new automated equipment work.

Education of operational level personnel is extremely crucial, and must be satisfactorily accomplished before training can be effective. Operators need to have the big picture. That is, they need to know how the work they will be doing fits into the full range of the organization's operations. What can you do to make this happen? Here is a checklist of specific educational tips that will make your ultimate training a lot easier.

- * Bring in books, films, videotapes, and people - about computer-aided design and drafting as well as about computer-aided manufacturing. The idea is to let workers know what the technol-

ogy is doing for people like themselves working elsewhere.

- * Don't oversell. The technology is impressive enough without sugar-coating it, and most workers know when they are being "conned."
- * The benefits of the various technologies, as reflected in productivity improvement in other organizations, will be clear to the workers. Benefits that will perhaps be less clear and will require some clarification are: improved working conditions - especially in the case of automation of manufacturing operations; upgrading of job descriptions, especially in the case of computer-aided design and drafting; and improved advancement opportunities. These do need to be spelled out, but in a forthright and non-patronizing manner.
- * "Quality circles." Groups of workers are given time to discuss possible improvements in the way things are done within the scope of their activities. Quality circles have been working very successfully for years in Japan and in other countries, and are only beginning to gain some popularity in this country. Think about starting a quality circle program in your organization. It will provide excellent preparation for the education and training that must precede and accompany the introduction of automation. (For more info, contact the Society on Manufacturing Engineers, P.O.B. 930, Dearborn, Michigan 48128; tel. 313-271-1500.)

SUM UP: Training will only "take" in a properly prepared person. Providing the right kind of education will pay off in terms of lower training costs. Quality circles help retain - and even amplify - the benefits of good training.

NEW TECHNOLOGY

3D DISPLAYS

The notion of having actual three-dimensional displays of objects (and not just

two-dimensional projections of three-dimensional objects) is not a new one. However, doing it had not been possible. The advent of the laser and laser holography seemed to promise that computers would, be generating three-dimensional images difficult to distinguish from the real object within a short time.

But, in 1981, years and years after the invention of holography, that technique has yet to manifest the qualities necessary to produce such a device.

Today there are in development at least two devices that offer a tantalizing promise of true, three-dimensional displays. Both devices are operational and are only a short way away from being commercialized.

One device is called "SpaceGraph." This device was developed at Bolt, Beranek and Newman, in Boston, Massachusetts. Genisco (3545 Cadillac Avenue, Costa Mesa, CA 92626) has acquired the technology, with the intention of making it commercial within a relatively short time. What is it? It's a vibrating vinyl concave mirror whose concavity changes under computer control. The viewer faces the mirror. Also facing into the mirror is a CRT, under the control of the same computer. The image on the CRT and the vibrations of the mirror are coordinated to produce a virtual image that appears to stand in front of the CRT and which can be viewed from a wide range of angles. Currently, the device is only monochromatic, because color phosphors on the CRT have too high a persistence to permit their use in this application.

The second device is simpler in concept. It consists of a flat board which is covered with light-emitting diodes, and stands upright on a turntable. The functional prototype has a two-inch-square board containing sixty-four rows by sixty-four columns of light-emitting diodes (LED's). The turntable used is an old disk drive. The controlling computer comes from Heathkit. The device was constructed and can be seen at MIT's Innovation Center, 77 Massachusetts Avenue, Cambridge, Massachusetts - 617/253-1000.

The board rotates rapidly on the turntable. At each portion of a revolution, the intersection of the plane of the board with the three-dimensional object being represented is computed by the computer and the appropriate LED's are turned on and off. The net effect is that an image of the three-dimensional object being represented appears in glowing red dots floating above the turntable. The image can be made larger, or smaller, or rotated.

The idea of a three-dimensional image generation system is to eliminate the need for visualization, which is required of operators of CRT base systems that show a two-dimensional projection of a three-dimensional image. Initial applications will probably deal with simple piece parts whose convoluted nature may make them difficult to visualize on the two-dimensional display. As the size of the display increases, it is clear that such a display would be a very good candidate for replacing engineering models, currently built at great expense prior to the construction of large petrochemical plants. Accommodation of this order of complexity is probably two to three years away, in terms of these technologies.

SUM UP: True 3D displays are almost here. Should you wait for them before buying any CAD/CAM equipment? Probably not; most of the need for 3D can be satisfied by CRT's today.

USER ACCOUNTS

CAD AT FREUHAUF / A GRADUAL CLIMB TO HIGH PRODUCTIVITY

Computer-aided drafting has been in use for over four and one-half years at the Freuhauf Division of Freuhauf Corporation, in Detroit, Michigan. Freuhauf manufactures large trailers, and has owned and extensively used an Auto-trol AD/380 system for over four and one-half years now. The system consists of a Sperry Varian V77-600 minicomputer with six graphics workstations, two alphanumeric workstations, a flatbed plotter, and an electrostatic plotter. Ninety-five percent of

all the drawings now produced by Freuhauf are done with the computer-aided design system. The system is centralized; all the workstations are near the computer, and all the operators are dedicated.

CAD/CAM ALERT interviewed Sharad Sheth, Director of Engineering Systems and Project Planning at Freuhauf. Mr. Sheth reported that productivity improvement ratios of between three- and four-to-one (on revisions to existing drawings), and between five- and six-to-one (on the creation of drawings similar to existing drawings) have been found.

These productivity improvement ratios, however, were not attained upon the first day of system installation. During the first six months, there was actually a decrease in individual productivity. However, the second six months showed sufficient gain to bring the average productivity for the first year of operation - during which there were only four stations on the system - to one-to-one. That is, during the first year of operation, the operators produced the same number of drawings as they would have had they not been using an automated system. During the second year, the average rose to two-to-one; since the third year, the productivity improvement ratio average has been in the ranges mentioned above.

Before the Auto-trol system was selected, all of the major vendors of interactive graphics systems were considered from time to time over two-and-one-half years, before settling on Auto-trol.

The company is pleased with the system operation. Average system down time is between two and five percent per day.

When a drawing is produced on the system, the electrostatic plotter is used to make a reference copy, which is returned to the originator for checking. The final copy is produced on the pen plotter. Freuhauf is considering using the electrostatic plotter more extensively as the final hard copy output device. The present problem with the electrostatic unit is obtaining a high enough contrast ratio between the image and the paper to permit

adequate microfilming. The company is considering a direct output to computerized output microfilm, but has not yet had time to investigate this alternative completely.

At the present, about 25% of the system time is used for design work or pre-design preparation work. Many of the system operators are actually more qualified than draftsmen; they are designers with product knowledge. Freuhauf has a policy of having system operators work in the design department for a time.

The system is not being made available for casual use by the engineers; there is simply too much of a backlog of work to permit this type of experimentation, although they hope to investigate this possibility further in the future.

Until fairly recently, most initial operator training was performed by the vendor. Now there is an in-house training program where operators are taught to use the system while learning Freuhauf procedures simultaneously.

The system was operated for three shifts till about two years ago. Since then it has been run on a two-shift basis: Each operator spending a full shift working with the system workstation.

Freuhauf is now considering expansion of its CAD/CAM capabilities, and integrating them with engineering analysis.

COMMENT: Detroit is frequently maligned for being slow to automate manufacturing processes. At the same time, "MoTown" has always been in the forefront of applying computers to design and drafting. As Detroit's economic condition now illustrates, CAD savings can have but a small effect on the overall financial condition of hard goods manufacturers; it is in CAM that factories will get the full benefit of computer technology.

EVENT NEWS

ICAM, CAM-I AND IGES

ICAM definition methodology (IDEF₀) released to Computer-Aided Manufacturing International, Inc.

The United States Air Force has released to Computer-Aided Manufacturing International, Inc. (CAM-I) the following information generated by the Integrated Computer-Aided Manufacturing (ICAM) program:

- A. Definition methodology (IDEF₀);
- B. Composite model of manufacturing architecture;
- C. Index of manufacturing architecture contents.

In his letter of release, and in his remarks to the attendees of the International Spring Seminar presented by CAM-I, Mr. Dennis E. Wisnosky (Acting Chief, Computer Integrated Manufacturing branch, Manufacturing Technology Division, Department of the Air Force, Air Force Wright Aeronautical Laboratories, (AFSC) Wright Patterson Air Force Base, Ohio) stated, "It has always been our hope that IDEF₀ would be adopted as a standard for communication of complex systems definitions in the United States. Adoption of IDEF₀ by CAM-I will expand this standard to all new markets, improving the ability to understand manufacturing concepts being developed throughout the world. The prospect of tapping this expanding source is both exciting and important to ICAM and CAM-I."

Mr. Wisnosky further stated, "The composite model of the manufacturing architecture and the wall chart produced by the ICAM program constitute the best description of manufacturing produced to date, reducing the black magic of manufacturing to a scientific description. This architecture has served as a good management control tool for the ICAM program office, and is offered as a strawman input for the CAM-I framework project. We hope that this architecture produced with the IDEF₀ methodology will not only be an important input to the framework project, but will further improve the mutual understanding we hope to build between ICAM and CAM-I."

It was further pointed out that, "The CAM-I office is free to disseminate the information altered or otherwise, without reservation as prescribed by CAM-I's own by-laws." Inquiries on the advance orders for this two-part, 200-page document can be made through the CAM-I Library. Only charges for reproduction (approximately \$50.00) will be assessed on prepaid orders.

Contact: Mr. C. H. "Pete" Link, Vice President and General Manager, CAM-I, 611 Ryan Plaza Drive, Suite 1107, Arlington, Texas 76011. Telephone: 817/265-5328.

OPERATIONS OPTIONS

CENTRALIZATION VS. DECENTRALIZATION

When considering a computer-aided design and drafting system, one of the most frequently-asked questions involves whether the system should be centrally located and operated, or if the workstations of the system should be distributed among the operating departments.

There is no firm rule here. In general, it is easier to measure productivity improvement when the system is totally centralized. When operators whose sole function is to turn out drawings - that is, strictly automated drafting - report to a single boss, and operate the system on a regular basis, we find that results are easier to measure.

On the other hand, most engineering organizations have some sort of a matrix organization, with personnel reporting to one set of managers on an administrative basis, and to project leaders on a project basis. In this situation, it is frequently more convenient to distribute the workstations to the individual projects, and have the computer plotter and peripheral equipment operated centrally, by a computer operations group.

Here are the main advantages of centralized operation:

- * System workload is easier to balance since all workstations are under control of one boss;

- * Maximum system utilization is easier to obtain than when using distributed systems;
- * Centralization facilitates monitoring of the work flow;
- * Personnel considerations, such as hiring and training, are simpler in a centralized environment.

The key benefits of using the workstations in a decentralized environment (that is, distributed to the working projects) are:

- * The automated system is far more accessible as a design tool that can be responsive to the needs of a particular project;
- * Project manager retains more direct control over the project documentation;
- * Long - and possible kinky - lines of communication among engineers, designers, and system operators are reduced or eliminated.

SUM UP: Hardware and software are available today to support either kind of operation almost equally well. The specific choice as to whether to operate the system on a centralized basis or decentralized basis will be dictated by the individual situation. Where CAD system ROI is important, centralized operations are almost always dictated; where highly decentralized project management is practiced, decentralization of CAD makes sense.

Hardware development directions seem to favor decentralization; control and cost considerations mitigate against it. Follow our case studies to learn from others.

FOR PROSPECTIVE USERS THE CAD FEASIBILITY STUDY

If you followed the instructions given in this column last month, you have now managed to sell the notion of computer-aided design and drafting to your management. The next step for you is to perform a CAD Feasibility Study. You are far more likely

to be ultimately successful if you consider the Feasibility Study to be an activity, the purpose of which is to answer the question, "CAD: No or Maybe?"

We do not attempt to answer the question in the affirmative because of the concept of creeping commitment, the idea that we don't have to make all of the decisions about CAD at one time. Rather, we can approach the subject a step at a time. Also, negative indications for CAD are easier to recognize than positive ones. Hence, the purpose of the Feasibility Study is to uncover any sizable obstacles to CAD. Also, it will turn up, for further investigation, areas that give promising signs of a profitable implementation of CAD.

The key steps in the Feasibility Study are:

- * List - List all of the current picture-producing activities within the portion of the organization that you are considering. Then list all of the drawings that should be produced, but are not currently being produced.
- * Count - the numbers and types of drawings currently being produced per unit of time (week, month, year); then estimate how many drawings of the types that you envision, but that are not currently being produced, might be generated per unit of time.
- * Describe - each drawing activity in two or three paragraphs. How is the drawing produced? What is the use of the drawing? Who originates the request, and how is the request for a drawing or a drawing up-date processed?
- * Intangibles - List points that would be difficult to quantify, but which would have an effect on the implementation of CAD in your organization. For example, is there a union among the draftsmen or designers? Has management already expressed a definite need for CAD? Is your organization's major competitor taking business away from you because they have a CAD system and you don't?

* Analysis - With the help of an experienced user - either a vendor or a consultant - postulate how each of the processes might be automated. Think about, and write about, what this would mean to your organization in terms of economics, competitive advantage, and other factors.

* Select - Choose those applications that appear to be the most promising - either the most beneficial one from an economic point of view, or possibly the most advantageous from a competitive or political standpoint.

* Conclude - CAD should be further investigated by your organization at this time, or you should wait until certain events occur before pursuing the matter any further (these events might include: reorganization of the engineering department, further drop in the price of equipment, appearance of specific capabilities peculiar to your industry, etc.)

SUM UP: Upon completing the Feasibility Study, you will know if your organization should continue pursuing the investigation of CAD, or if it should simply stop looking in that direction until some other event occurs.

If the answer is no, you have spent only a small amount of resources to obtain this valuable information.

If the answer is maybe, the next step is an Applications Study, the purpose of which is to answer the question, "CADD: Yes or No?". The Applications Study will be described in detail in the next issue.

ON THE CAM FRONT

ROBOTS / QUALITATIVE AND QUANTITATIVE BENEFITS

The most intriguing aspect of computer-aided manufacturing is robots. The idea that we can construct a machine that somehow behaves like a person is of endless interest to writers, engineers, and people of all walks of life.

The word "robot" first appeared in a Czech play in the 1920's, about the dehumanizing effect of machinery in factories. It comes from the Czech "robota," meaning "compulsory service." The Robot Institute of America defines robot as, "a programmable multi-function manipulator designed to move materials, parts, tools, or specialized devices; variable programmed motions for the performance of a variety of tasks."

Robots are not at a point where they can truly compete with human functions. However, there are signs that such objects are not far off.

What are the key benefits robots are actually offering?

- * Faster cycle time;
- * Increased levels of utilization;
- * Increased output per shift;
- * Lower rejection levels;
- * Savings in materials.

Payback analysis for robots can be computed as follows: $P = I / (L - E)$ where "P" equals payback period in years, "I" equals the total investment in robot and accessories, "L" equals the total annual labor savings, and "E" equals the total annual robot upkeep cost. Multiple-shift usage reduces the payback period substantially.

Typical expenses to be considered in the acquisition of robots for industry include:

- * The purchase price;
- * Changes in existing plant layout to accommodate the robots;
- * Project engineering costs;
- * Staff education;
- * Installation and start up costs;

* Running costs.

The typical savings include:

- * Increased production;
- * Lower salary costs and overhead, through reduced manpower;
- * Improved product quality;
- * Savings of materials;
- * Lower turnover of employees;
- * Reduced maintenance to the factory;
- * Energy savings.

Estimates of the actual number of robots in use in the world today vary widely. Several estimates place approximately 10,000 robots in use in Japan alone (the world's largest user of robots) most of which are relatively simple "pick and place" units - with little or no feedback.

SUM UP: Robots are here - and working. They constitute a viable alternative to human labor for many tasks, and should not be ignored by manufacturing planners.

CALENDAR

JUNE 14-18, NCGA '81 - Baltimore Convention Center. An excellent show for beginners and experienced practitioners of CAD/CAM; tutorials, topical sessions and many, many exhibits.

CONTACT: NCGA, 2033 "M" Street, NW,
Washington, DC 20036
202/466-5895

JUNE 29 - JULY 1, ASM IEEE Eighteenth Design Automation Conference, Opryland, Nashville, Tennessee. The leading conference for design automation system designers and advanced users. Registration through June 12: \$95/members, \$115/non-members. After June 12: \$115/members, \$135/non-members.

CONTACT: Pat Pistilly, Bell Laboratories, Building 1E-11,
11900 North Pecos Street,
Denver, Colorado 80234
303/451-4364

AUGUST 3-7, SIGGRAPH '81, Dallas, Texas. The Eighth Annual Conference on Computer Graphics and Interactive Techniques has long been a meeting place for builders and developers of graphic systems. An extensive equipment exhibit accompanies the conference.

CONTACT: Dr. Douglas Green, Department of Electrical Engineering,
Texas A & M University,
College Station, Texas 77841

OCTOBER 27-29, CG'81, Regent Centre Hotel, London, England. An international meeting, with several CAD/CAM-related sessions.

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44-9274-28211

EDITOR'S NOTE

Thanks to our readers for the many positive comments about CCA #1. If you haven't yet done so, now is a good time to write and tell us if we are addressing your needs. We're here to serve you, and we need feedback. Right? Write!

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